Missouri Department of Natural Resources
Water Pollution Control Program

Total Maximum Daily Load (TMDL)

for

Kelley Branch
and
Rocky Fork
Boone County, Missouri

Completed August 15, 2003
Approved December 19, 2003

Two Phased Total Maximum Daily Loads (TMDLs)
For Kelley Branch and Rocky Fork
Pollutant: Sediment-Kelley Branch (Listed for Habitat Loss in 1998)
Pollutant: Sediment—Rocky Fork

October 24, 2003

Name: Kelley Branch and Rocky Fork

Location: North of Columbia in Finger Lakes State Park in Boone County, Missouri

Hydrologic Unit Code (HUC): 10900102

Water Body Identifications (WBID): 1016—Kelley Branch
1014—Rocky Fork

Missouri Stream Class: The impaired segment of Kelley Branch is a Class C stream[1]. The impaired segment of Rocky Fork is also a Class C stream.

Beneficial Uses for both streams[2]:

- Livestock and Wildlife Watering
- Protection of Warm Water Aquatic Life and Human Health associated with Fish Consumption

Size of Impaired Segment: WBID 1016 1 mile
1014 0.5 miles

Location of Impaired Segments: 1016 SE 36, 50N, 13W to NE36, 50N, 13W
1014 , NE 1, 49N 13W to SE36, 50N, 13W

Pollutants: Habitat Loss—Kelley Branch
Sediment—Rocky Fork

Pollutant Source: Off Road Vehicles use Finger Lakes State Park—Kelley Branch
Off Road Vehicles use Finger Lakes State Park—Rocky Fork

TMDL Priority Ranking: High for both Kelley Branch and Rocky Fork

[1] Class C streams may cease flow in dry periods but maintain permanent pools, which support aquatic life. See 10 CSR 20-7.031(1)(F)
[2] For Beneficial uses see 10 CSR 20-7.031()(C) and Table (H)

1.0 Background and Water Quality Problems

The 1,131-acre, Finger Lakes State Park is located in the Missouri River section of the Ozark Border Natural Division. It is made up of previously disturbed and partially reclaimed, strip-mined land. Soils are primarily derived from glacial till and loess, but most of the topsoil was buried beneath subsoil during the mining process. Much of the soil that remains is classified as Lenzburg gravelly silty clay loam, 9-70% slopes; and Keswick silt loam, 5-9% slopes, eroded. Lenzburg soil, the predominant soil in the drainage area, is in the NRCS Hydrologic Group designation B—having a moderate infiltration rate when thoroughly wet and a moderate rate of water transmission or "runoff". Keswick and the other soils in this watershed, however, have a rapid rate of runoff.

The pre-settlement condition of the park was known to consist of rolling hills, open fields and virgin timber. A roofing mill and molasses mill operated on the site in the 1860's. The tract was logged off and by the early 1900's cattle grazing and row crop cultivation were the primary land uses. Between June 1964 and October 1967, the Peabody Coal Company removed more than 1.2 million tons of coal from the site, then called the Mark Twain Mine. In an effort to revegetate the area in the mid-1960's, Peabody Coal planted over 500,000 tree seedlings of mixed species and 18,000 seed pounds of grasses and legumes and stocked the pits with fish. This reseeding project resulted in limited success. The rugged terrain left by the mining activities, approximately 42% of the park, was not changed. Peabody Coal donated the land to the state park system in 1974. This location was chosen by the U.S. Department of Interior in May 1974 to demonstrate the feasibility of converting strip-mined land to recreational use.[3]

The park topography consists of small, steep-sided hills with many small ponds in between the hills. This has made the area a popular spot for recreational off road vehicle (ORV) use. The more than 70 miles of off-road motorcycle and all-terrain vehicle trails and motocross track attract people from around the country. The professionally designed motocross track features motocross and motorcycle races as well as mountain bike events yearly.[4] In 2002, the latest year for which records are available, 14,797 ORV riders utilized the park facilities.[5]

Most of the land within the park boundaries consists of a 30-year successional forest dominated by black locust, elm, sycamore, silver maple, red cedar and walnut trees. The mid-story plants include redbud, Ohio buckeye, box elder, dogwood and grape. Grasses, sweet clover and lespedeza grow in open areas. Non-native plant species are dominant on steep slopes and roadsides. The Missouri endangered plant, Slender Pondweed, (*Potamogeton pusillus* var. *pusillus*) was tentatively identified as growing in the park and protection of that species is considered a priority.

Finger Lakes State Park lies entirely within the Rocky Fork Creek watershed. Over 70 separate bodies of water are located in the park. Many small lakes were created by the mining operation, but several were joined together with dams and canals to create more than a 1 ½ mile corridor of

[3] Finger Lakes State Park Natural Resource Management Plan, Missouri Department of Natural Resources, Division of State Parks and Historical Sites, 1998.
[4] Finger Lakes State Park web site, http://www.mostateparks.com/fingerlakes/geninfo.htm
[5] Yearly Attendance Report, Finger Lakes State Park, Missouri Department of Natural Resources.

water suitable for canoeing, fishing, swimming and scuba diving. Kelley Branch, the primary intermittent stream in the basin, flows from north to south through the center of the park. Toward the southern end of the park, Kelley Branch appears to have been extensively channelized during the mining process. The stream is essentially a straight ditch lacking normal riffle/pool characteristics or normal meanders.

Although Kelley Branch is not completely accessible to ORV traffic driving up and down the stream, there are many crossings and some areas of longitudinal impact. Trail crossings are sometimes wide and often eroded. Not only do ORVs cross the stream and disturb sediment, but streamside trails also function as conduits for erosion and sediment run-off. Park personnel have created "official" stream crossings and are discouraging use of other crossings by creating obstacles and discontinuing use of some trails.

At the southern end of the park, Kelley Branch exits through two large culverts under a Peabody Haul Road and drops approximately three feet into an artificial pool constructed by the Missouri Department of Transportation and from there into the streambed. Any fish or macroinvertebrate passage upstream from this point is impossible. During heavy storms, any organisms living in Kelley Branch get washed downstream past the culvert and are then unable to return. This severely limits the amount and diversity of species living in the stream within the park. Immediately south of the park boundary, Kelley Branch joins Rocky Fork. About one-half mile of Rocky Fork has impaired aquatic habitat due to excessive sedimentation that appears to be eroding from the stream or riparian areas of Kelley Branch within the state park. Upper Rocky Fork also drains abandoned mine land.

A Missouri Department of Conservation study on Kelley Branch conducted in July 2000 found seven species of fish in the creek. Fish collected in the stream included young largemouth bass, orangethroat darter, blackstripe topminnow, bluegill, creek chub, yellow bullhead and common shiner. The study noted that "it was very difficult for fish to move to this reach due to the barrier produced by culverts at bridges.[6]" MDC staff concluded that the fish population in Kelley Branch is from fish washing down from upstream lakes, since it is impossible for fish to pass through the culvert at the south end of the park due to the excessive drop.[7] Fish habitat was described as highly impacted by sedimentation resulting from ATV (all terrain vehicle, a synonym for ORV) use through and along the stream. The stream bottom was noted as highly embedded (percent embeddedness from 50 transects was 87.4%) with sand and fine sediments. And fish cover was virtually non-existent due to sedimentation in pools. The tree canopy over the stream was thick, but the understory and ground cover were disturbed from heavy ATV use. Ground cover was greater than 40% bare dirt. The mean wetted width was 3.93 meters or 12.9 feet with a mean thalweg (stream bottom) depth of 14.9 cm or 5.9 inches. Mean depth from 100 measurements found 91% of the thalweg measurements had fine sediments present. Temperature measured 20° C (68° F). Dissolved Oxygen was 7.0 parts per million. pH was 7.6 and the conductivity was 820 μS. Another study was attempted in September 2002, but the creek was dry at that time with few pools and heavy ATV traffic was noted. The field notes concluded with the observation that this was a "very degraded site."

[6] E-mail communication, Steve Fischer, Missouri Department of Conservation, 3/12/03.
[7] Personal communication, Steve Fischer, Missouri Department of Conservation, 5/21/03.

On a natural landscape, vegetation covers the soil and holds it in place with its roots. Even so, a small amount of soil always moves into streams and in this context can be a valuable resource for stream habitat. On a disturbed landscape, however, vegetation is sparse and is unable to keep soil in place. Windblown and waterborne soil moves into streams and results in deposition and degradation of habitat by filling in pool habitats, causing difficulty for sight feeding fish and smothering fish eggs. It can also fill the interstitial spaces on the stream bottom and negatively impact the habitat of aquatic insects.

Another consideration is the gradient of the listed stream segments. Topographical changes in the gradient have an effect upon the deposition of sediment. Steep slopes allow sediment to wash into and be carried along by stream flow in the creek. Once the gradient changes to a lower slope, the sediment suspended in the water settles out by gravitational forces. According to topographical maps, Kelley Branch appears to have an approximate gradient of 25 feet per mile and Rocky Fork has a drop of approximately 12.5 feet per mile. This would result in a natural dropout of sediments at the point where the gradient changes in Rocky Fork.[8]

A further problem the park has dealt with is an overpopulation of beaver. A stable population of beaver is considered beneficial in that they create and maintain wetlands and wildlife habitat. This is especially important in such a drastically altered area as exists in the State Park. Also, the park is one of the best locations near an urban area to view beaver. Unfortunately, too many beaver cause trouble by plugging culverts, flooding trails, and destroying trees in the riparian corridor. On two occasions, beavers have been trapped and removed to reduce damage.

A Missouri Department of Natural Resources, Land Reclamation Program report detailed the mining activities that have occurred in the Finger Lakes State Park and the Rocky Fork Conservation Area. The report was written for an educational workshop held in May 2002. A summary of this information is contained in Appendix D, Other Reports. The report states that erosion from a slurry pit located in the Rocky Fork Conservation Area has caused fish kills in the past and questioned the long-term success of the reclamation effort. This area is upstream of the impaired section of Rocky Fork and the portion of stream that will be used as a control to assess the effectiveness of the TMDL.

On October 3, 2003, department staff conducted a site visit to determine if the erosion mentioned in the Land Reclamation report has an impact on the lower segment of Rocky Fork addressed by this TMDL. Conductivity and pH measurements were taken at two locations on Rocky Fork, one location on Kelley Branch and at five sites within the conservation area where the erosion is occurring. The streams were at a fairly low flow state at the time of sampling. Kelley Branch is not downstream of the eroding mine land. Consequently, the data collected on Kelley Branch should represent expected values if ORV's are the sole source of the observed impacts.

Mine drainage in Missouri is typically high in sulfates and very acidic. High sulfate and chloride concentrations can be detected by measuring conductivity. A high conductivity reading coupled with a low pH would indicate an impact from eroding mine land. The five sites sampled within the Rocky Fork Conservation Area all had high conductivity readings, ranging from 2120 to

[8] Memorandum, Randy Sarver, Missouri Department of Natural Resources, Environmental Services Program, 6/29/01.

4280 μS and pH values ranging from 2.7 to 6.8. These values would indicate varying degrees of impact from the mine land erosion. The values obtained in lower Rocky Fork and Kelley Branch were significantly different from the values found in the conservation area. The conductivity ranged from 828 to 883 and the pH ranged from 7.4 to 7.7. This would indicate the eroding slurry pit is not impacting the lower section of Rocky Fork during the time of sampling. Based on field observations, staff reached the same conclusion using best professional judgement. The implementation and monitoring plans developed for this TMDL are, therefore, considered to be valid. A summary of the data and observations are found in Appendix D, Other Reports.

Although impacts of the eroding mine land were not observed to have an impact at the time of the field visit, there is the potential for the slurry pit area to impact lower Rocky Fork. A formal request will be made to the Missouri Department of Conservation to remediate the eroding mine land in the near future.

2.0 Description of the Applicable Water Quality Standards and Water Quality Targets

2.1 Beneficial Uses

Kelley Branch/Rocky Fork has the following beneficial uses on both impaired waterbody segments:

- Livestock and Wildlife Watering
- Protection of Warm Water Aquatic Life and Human Health (associated with) Fish Consumption

2.2 Anti-degradation Policy

Missouri's Water Quality Standards include the Environmental Protection Agency (EPA) "three-tiered" approach to anti-degradation, and may be found at 10 CSR 20-7.031(2).

Tier I defines baseline conditions for all waters and requires that existing beneficial uses are protected. TMDLs would normally be based on this tier, assuring that numeric criteria (such as dissolved oxygen and ammonia) are met to protect uses.

Tier II requires that no degradation of high-quality waters occur unless limited lowering of quality is shown to be necessary for "economic and social development." A clear implementation policy for this tier has not been developed, although if sufficient data on high-quality waters are available, TMDLs could be based on maintaining existing conditions, rather than the minimal Tier I criteria.

Tier III (the most stringent tier) applies to waters designated in the water quality standards as outstanding state and national resource waters; Tier III requires that no degradation under any conditions occurs. Management may prohibit discharge or certain polluting activities. TMDLs would need to assure no measurable increase in pollutant loading.

These TMDLs will result in the protection of existing beneficial uses, which conforms to Missouri's Tier I anti-degradation policy.

2.3 General Criteria

General criteria contained in Missouri's Water Quality Standards 10 CSR 20-7.030 (3)(A)(C) and (G). These criteria state:

- (A) Waters shall be free from substances in sufficient amounts to cause the formation of putrescent, unsightly or harmful bottom deposits or prevent full maintenance of beneficial uses;
- (C) Waters shall be free from substances in sufficient amounts to cause unsightly color or turbidity, offensive odor or prevent full maintenance of beneficial uses;
- (G) Waters shall be free from physical, chemical or hydrologic changes that would impair the natural biological community.

3.0 Allocations for Sediment

3.1 Loading Capacity

Loading capacity is defined as the maximum pollutant load that a waterbody can assimilate and still attain water quality standards. Loading Capacity (LC) is the sum of the Waste Load Allocation (WLA), the Load Allocation (LA), and the Margin of Safety (MOS). This can be expressed as an equation:

LC = WLA + LA + MOS

The Loading Capacity, that is, attainment of beneficial uses, is determined in this TMDL through the use of surrogate targets. These targets are expressed in the short, medium and long-term goals outlined below. Missouri does not have numeric goals for sediment or habitat loss, so surrogates have been used to determine water quality standard attainment.

3.2 Waste Load Allocation (Point Sources)

The Waste Load Allocation is zero, because there are no point sources of sediment in the watershed. If any point source is proposed in the future, the Waste Load Allocation will likely not be revised. Point sources may contribute to volatile suspended solid loading, but rarely are a source of non-volatile suspended solids. The impairment in these waterbodies is sediment, which is a non-volatile suspended solid.

3.3 Load Allocation (Non-point sources) and Endpoint

The Load Allocation includes all existing and future non-point sources plus the natural background (40 CFR § 130.2(g)). The impairments to Kelley Branch and Rocky Fork are listed on the 1998 303(d) Impaired Waters List as habitat loss and sediment, respectively.

Missouri's water quality standards do not include numeric criteria for sediment. Sediment has an indirect effect on stream habitat by creating an environment where fish have difficulty finding food due to turbid water and silt deposits cover fish and macroinvertebrate habitat. A decreased

sediment load would improve the impaired stream segments by creating better habitat for aquatic life and thus allow Kelley Branch and Rocky Fork to meet water quality standards.

Studies have shown that forestlands generally have small amounts of erosion, typically less than 0.13 tons/acre due to increased cover and the filtering effect of the forest floor.[9] Roads in forested areas have been recognized in several studies, however, as being a high generator of stream sediment, as much as a tenfold increase over background levels.[10] Schiess and Krogstad's study did not find that the presence of roads themselves produced the sediments, but that heavy road use was the culprit, and that vehicle traffic resulted in active erosion and delivered excess sediment to streams. They found that "road–stream separation" was the answer to reducing sediment delivery and that the further the sediment had to flow across the forest floor, the more filtering occurred and the less sediment got into the stream. The heavy ORV use of trails (roads) in the park and the constant establishment of new trails in the riparian corridor increases the amount of sediment entering the stream and impairs stream function. The park has begun blocking off trails that funnel sediments into the stream and have initiated the installation of alternate stream crossings, such as hardened crossings and bridges. Research in conjunction with this TMDL will assess reference conditions, evaluate riparian improvements and determine whether more stringent action is needed to achieve sediment reduction goals.

The impaired segments of Rocky Branch and Kelley Fork drain areas of historic mining and as such are not considered natural areas. Strip-mining affects all the drainage area of Kelley Branch and much of the drainage area of Rocky Fork. In the past a location on Rocky Fork Conservation Area was a problem and could reemerge as a problem. A Missouri Department of Natural Resources, Land Reclamation Program report questions the long-term success of the reclamation, and they have concerns that much of the reclamation work south of Rocky Fork Lake is being "burned out" by acid-forming materials[11]. At this time, upper Rocky Fork does not have the same degree of sedimentation as the impaired segments of both lower Rocky Fork and Kelley Branch, even though it also drains abandoned mine land. This could partially be due to the reclamation work on Rocky Fork adjacent to the state park on the Missouri Department of Conservation's Rocky Fork Conservation Area. Wetlands reduce downstream sedimentation by trapping eroded soil within the wetland. If sediment continues to be a problem in the impaired segments after the best management practices (BMPs) are implemented, the feasibility of constructing a wetland in the state park should be considered.

The best available science does not provide a conclusive link between sediment delivery (that is, watershed conditions) and the quality of aquatic habitat.[12] This is because it is natural processes like rainfall patterns, sediment movement and sediment delivery are so variable and difficult to measure. The approach used for a TMDL depends heavily on the existence of historic data to determine sediment load reductions needed and to allocate loads. Little to no data exists on the

[9] Grace III, JM; Sediment Movement from Forest Road Systems; American Society of Agricultural Engineers, 2002, ppg 13-14.
[10] Schiess, P; F. Krogstad, Sediment and Road Density Reduction, University of Washington College of Forest Resources, Forest Engineering and Hydrology Program, Fact Sheet #4, 11/2000,.
[11] Missouri Department of Natural Resources, Land Reclamation Program Report, Rocky Fork/Finger Lakes Mining Area, 2002.
[12] Lisle, T.; S. Hilton; Fine sediment in pools: an index of how sediment is affecting a stream channel; Fish Habitat Relationship Technical Bulletin Number 6, 12/91.

extent of sedimentation in the impaired segments of Kelley Branch and Rocky Fork upon which estimates for the needed load reductions could be based. Given the lack of data, indicators will be used instead of load allocations in this TMDL. No single indicator best applies to all situations, so attainment of targets will be evaluated using a weight-of-evidence approach. Also, a reference stream will be used to indicate when the impaired segments reach the water quality targets. Upper Rocky Fork has a similar topography to the impaired segments of Kelley Branch and lower Rocky Fork, including abandoned mine land, but presently does not have the same sediment deposition problems. An appropriate site on upper Rocky Fork will be chosen for use as a reference condition.

The target or endpoint of this TMDL will be a 50% reduction in fine sediment in pools in the impaired segments of Kelley Branch and Rocky Fork. Achievement of this endpoint would create the best habitat possible considering the area has experienced severe land disturbance in the past due to mining activities and continuing disruption from the use of the park for ORV riding. Because this abandoned mine land has had reclamation projects completed in the past and is only one of two parks in the state park system available for ORV riding, it is unlikely this area will be reclaimed further. The endpoint will be considered achieved and beneficial uses met when a 50% reduction of fine sediment in pools occurs in the impaired segments of Kelley Branch and Rocky Fork; the load allocation is a 50% reduction of fine sediment from the initial conditions. Additionally, embeddedness and the aquatic community will be evaluated to determine whether habitat conditions are improving. Ultimately, the best condition would be for fines in pools to be within 10% of the reference condition.

Best management practices already implemented and those scheduled for completion by 2004 will be assessed to determine if sediment reductions are being achieved and to evaluate if more action is needed to reduce the sediment load to acceptable levels. Because the state of Missouri takes a phased approach to TMDLs, the park will continue to construct the BMPs and the department will monitor their effectiveness. These BMPs are expected to achieve results to allow the impaired segments meet water quality standards. BMPs are discussed in the **Implementation** section of this TMDL.

Following are Missouri's Non-point Source Surrogate Targets as outlined in short, medium and long-term goals designed to achieve water quality standards for Kelley Branch and Rocky Fork.

Short Term Goals – current measurement of stream and sediment supply to impaired segments using Upper Rocky Fork as a reference condition

Indicator	Target	Description	Purpose	References
V*--lower order streams	Presently 91% of transects contain fine sediments; Initial target – determining condition and improving trend over present condition	Fraction of pool volume filled by fine sediment	Indicates annual sediment yield	Lisle and Hilton, 1992, 1999
Riffle embeddedness	Presently 87.4%; Initial target--75% or "Poor" condition	Percent of gravel surrounded by fine sediment	Indirect measure of sedimentation affecting habitat	Stream Habitat Assessment Project Procedure; MDNR 2000
Aquatic Invertebrate Community Measurements	Improving trends	Measures of insect diversity and measures of "clean water" insects	Measure of capability of stream to support aquatic insects and fish	Semi-Quantitative Macroinvertebrate Stream Bioassessment, 2001
Soil loss estimate = <u>15.85</u> tons per acre per year (See "3.4 Soil Loss" below for calculations)				

Mid-Term Goals – Response after some restoration activities

Indicator	Target	Description	Purpose	References
V*	Ongoing target – 20% better score than initial condition	Fraction of pool volume filled by fine sediment	Indicates annual sediment yield	Lisle and Hilton, 1992, 1999
Riffle embeddedness	Ongoing target 50% or "Fair" condition	Percent of gravel surrounded by fine sediment	Indirect measure of sedimentation affecting habitat	Stream Habitat Assessment Project Procedure; MDNR 2000
Aquatic Invertebrate Community Measurement	Improving trends from initial condition relative to reference stream	Measures of insect diversity and measures of "clean water" insects	Measure of capability of stream to support aquatic insects and fish	Semi-Quantitative Macroinvertebrate Stream Bioassessment, MDNR 2001
Soil loss estimate: A STEPL sediment spreadsheet will be done to ascertain more accurately how much soil is being deposited in Kelley Branch and lower Rocky Fork.				

STEPL (Spreadsheet Tool for Estimating Pollutant Load) uses algorithms to calculate nutrient and sediment loads from different land uses and the load reductions that would result from the implementation of various best management practices. It computes watershed surface runoff;

nutrient loads and sediment delivery from on land uses and management practices. It is based on the Universal Soil Loss Equation.[13]

Long-Term Goals – Sustaining conditions of impaired segments of Kelley Branch/Rocky Fork

Indicator	Target	Description	Purpose	References
V*	Sustaining level within 10% of reference stream or 50% reduction of fine sediment from initial condition	Fraction of pool volume filled by fine sediment	Indicates annual sediment yield	Lisle and Hilton, 1992, 1999
Riffle embeddedness	Sustaining level 50% or "Fair to Good" condition	Percent of gravel surrounded by fine sediment	Indirect measure of sedimentation affecting habitat	Stream Habitat Assessment Project Procedure; MDNR, 2000
Aquatic Invertebrate Community Measurement	Sustainable level of adequate habitat for aquatic life given the limitations of AML site	Measures of insect diversity and measures of "clean water" insects	Measure of capability of stream to support aquatic insects and fish	Semi-Quantitative Macroinvertebrate Stream Bioassessment, MDNR 2001
Soil Loss Estimates: Adaptive management will be used to determine whether more extensive best management practices are necessary to achieve sustainable soil loss reductions.				

3.4 Soil Loss

The Universal Soil Loss Equation (USLE) was used to estimate soil loss in the Kelley Branch watershed. The United States Department of Agriculture developed the USLE calculation using analysis of rainfall, runoff and sediment loss data. A newer version called RUSLE (Revised Universal Soil Loss Equation) is available, but for this limited application, the USLE is adequate and does not require a computer program to perform whereas RUSLE does require computer capability. USLE is figured by multiplying rainfall, soil erodibility, slope length and steepness, vegetative cover and conservation practices to supply an estimate of soil loss shown in tons of sediment lost per acre per year. The equation is **A = RKLSCP**.

A = Average annual soil loss in tons per acre per year
R = rainfall and runoff erosivity index for a given location
K = soil erodibility factor
L = slope length factor
S = slope steepness factor
C = cover and management factor
P = conservation or support practice factor

[13] U.S. Environmental Protection Agency website, "Welcome to STEPL and Region 5 model", 7/3/2003, http://it.tetratech-ffx.com/stepl/

Universal Soil Loss Equation Calculations for Kelley Branch				
Soil Type	Lenzburg 9-70%	Keswick 9-14%	Vanmeter 5-14%	Lenzburg 2-9%
R	225	225	225	225
K	.24	.37	.28	.24
LS	9.1	2.26	3.9	1.6
C	0.14	0.14	0.14	0.14
P	1.0	1.0	1.0	1.0
Sediment Yield Factor	30%	40%	50%	50%
Soil Percentage of Total	69%	9%	3%	3%
Weighted Avg tns/ac/yr	20.6	10.5	17.2	6.0
15.85 tons/acre/year Estimated Weighted Average Soil Loss for Kelley Branch				

R for the Boone County area is 225.
K is taken from "Table 19. Physical Properties of the Soil" in the Boone County Soil Survey
LS denotes Length of Slope and Steepness. These numbers are derived from tables on the NRCS web site
C used is from "C" Factors for permanent pasture, rangeland and idle land used by the United States Army in calculating erosion on military bases
P figure used assumes no conservation practice measures are present
Sediment Yield is the estimated percent of soil loss from sheet and rill erosion leaving the site and entering waterbodies

Soil loss reductions will not be used as a target or endpoint but only as an indicator that soil loss is considered to be excessive. Soil loss reductions will be assessed according to the parameters given above, for example fines in pools, embeddedness and aquatic invertebrate community measurement.

Upper Rocky Fork has soils and topographical conditions similar to Kelley Branch, including extensive strip mining effects and it is assumed it has similar soil loss numbers. In the medium term goal, a more accurate assessment of soil loss for Kelley Branch and Rocky Fork will be calculated.

4.0 Margin of Safety

The Margin of Safety (MOS) is the prescribed mechanism to account for the uncertainty in determining the amount of pollution load and its effect on water quality. There are two ways for incorporating a Margin of Safety in a TMDL:

- Implicitly by incorporating the MOS using conservative assumptions to develop allocations. It is a built-in margin of safety.
- Explicitly by specifying a portion of the total TMDL as the MOS, and allocating the remainder to sources. It is some amount (like an additional percentage) added to the total to account for uncertainty.

The MOS in this TMDL is implicit because several targets were used in the short, medium and long-term goals. Using more than one surrogate provides multiple indicators to more accurately determine when water quality standards are met.

5.0 Seasonal Variation

The state park is used by ORV riders year round. Sediment, however, is moved into the stream when rain occurs. Sedimentation will be controlled by use of best management practices that will be in place year round.

6.0 Monitoring Plan For TMDLs Developed Under the Phased Approach Using Interim Goals

Phase 1 is the completion of the best management practices outlined in the Finger Lakes State Park's Management Plan. As a part of scheduled improvements, the state park began implementing BMPs in 2002 to reduce sedimentation in the impaired segments of Kelley Branch and Rocky Fork. By spring 2005 a sampling sites including the reference location will be chosen and the measurements of fine sediment in pools, embeddedness and biotic community will be taken using the approved methodology.

Phase 2 assesses the success of the BMPs installed and those scheduled for completion by spring 2004. A STEPL spreadsheet will be completed to assess more completely soil loss in Kelley Branch and Rocky Fork. These will be completed by January 2006.

Phase 3 completes monitoring by summer 2006. If monitoring indicates that further sediment reduction practices are necessary, those will be installed within three years of that decision.

7.0 Implementation Plan

Finger Lakes State Park is operated by the Missouri Department of Natural Resources State Park system primarily for the year-round use of Off Road Vehicle operators. The state park is addressing stream impacts due to sedimentation using the following Best Management Practices:

A. Establishment of appropriately located trails

Riding vehicles in the heavy mud causes the trails to widen as riders attempt to avoid or get their machines out of mud holes, so the trails tended to "wander". An "approved" main trail has been established on the west side of Kelley Branch marked by direction signs. Unapproved trails have been blocked off with natural barriers (fallen logs) or with artificial barriers (fences). Much of this work was completed by December 2002.

B. Construction of hardened stream crossings in appropriate areas

Two hardened stream crossings have been constructed using cobble-sized quarry rock placed in the stream to create a low-water crossing in an approved area. Trails have been rerouted to utilize these stream crossings. Approaches to the specially designed

crossings have been graveled to minimize erosion at these high traffic areas. One more hardened stream crossing is planned for construction by winter 2003/2004.

C. Construction of a bridge stream crossing to prevent destruction of stream bank in a high traffic area

Construction of a bridge in a high ORV traffic area near the south end of the park is being planned. Park staff plan to place a salvaged county road bridge to convey traffic across Kelley Branch from the main trail on the west side of the park to a large lake on the east side of the stream. This will require significant time to design and construct. No timetable has been set for completion of this project, but funding has been secured for the project. Engineering plans are not finished, but park staff anticipate the bridge project will be completed by fall, 2003.

D. Erect signage to direct traffic to designated trails and stream crossings

Signs are being constructed and will be placed to identify riding and non-riding areas. Approved trails, stream crossings and off-limit areas will be clearly marked. A sign placed at the entrance to the park informing riders that riding in the stream is prohibited is being constructed. Signs are expected to be in place by April 2003.

E. Education and information for ORV users

Educational literature is being developed to inform riders of the damage ORV traffic can have on the stream channel and will also notify them that such activity is prohibited.

F. Policy Enforcement

Although park policy already prohibits riding ORVs in the stream, the policy will be more strictly enforced in the future. The educational component will explain the necessity of staying out of the stream and using the designated trails and stream crossings. Consistent enforcement of the policy will be vital to the success of the best management practices in preventing soil erosion into Kelley Branch.

G. Construction of physical barriers to prevent access to the stream channel

Some natural barriers have been installed to direct riders to the designated trails and stream crossings. During the recreational season, these barriers' effectiveness will be evaluated. If effective, more will be installed. Artificial barriers will be erected as needed. The park staff anticipates that a combination of natural and artificial barriers will be necessary. Installation of barriers will be completed by spring 2004.

Park staff believe that the plan they have adopted to eliminate ORV traffic in the stream will permit the stream to naturally recover. They believe their plan will allow the stream to regain natural functions like meanders, pools and riffles through natural means like stream flows, rainfall events and freezing and thawing cycles. Realistically, lower Kelley Branch is a channelized stream, and it could take decades to regain natural characteristics. Future monitoring by the Missouri Department of Natural Resources will determine if water quality standards are being met.

The following best management practices are not a part of the State Park management plan. If monitoring indicates additional management practices are needed to address further sedimentation in lower Kelley Branch and lower Rocky Fork, they would be required under adaptive management

H. Construction of a wetland in lower Kelley Branch

Because of the longstanding sedimentation in Kelley Branch and lower Rocky Fork, a wetland may be necessary to control sediments resulting in impairment in the impaired segments. A wetland located in the lower reach of Kelley Branch would trap sediments and help prevent movement of sediment out of the park and into lower Rocky Fork. If monitoring indicates a wetland is needed, Park staff will consult the Missouri Department of Conservation to determine what measures to take to construct a wetland in the southern end of Finger Lakes State Park to prevent eroded sediment from leaving the park. The decision to construct a wetland will be made by the end of the assessment period. If future sedimentation becomes a problem past the assessment period, then installation of the wetland will be undertaken.

I. Construction of a impassable boundary between the riparian corridor and ORV traffic

Sedimentation and habitat destruction in Kelley Branch are in part caused by unrestricted ORV traffic in the creek. Under the adaptive management concept, if the best management practices are unsuccessful, then further practices are applied until improvement is seen. If those BMPs listed above are unsuccessful at stopping sedimentation in the listed segments, then an impassable barrier on either side of Kelley Branch would be erected in the park. The barrier could include a fence or natural barriers like boulders that would preserve a 30-foot riparian buffer on each side of the stream and would funnel riders to the authorized crossing points.

The Michigan Department of Environmental Quality estimates that healthy forest filter strips reduce sediment loads delivered to surface water from upland sources by 65%.

8.0 Public Participation

These two waterbodies are included on the approved 1998 303(d) list for Missouri. Six public meetings on impaired waters to allow input from the public were held between August 18 and September 22, 1998. No comments pertaining to the Kelley Branch/Rocky Fork were received during those public meetings. On March 7, 2002 MDNR TMDL Unit staff presented a program to the Boone County Soil and Water Conservation District board members explaining the TMDL process and outlining which streams in Boone County were scheduled for TMDLs, including Kelley Branch and Rocky Fork. Staff answered the board's questions regarding stream monitoring, Finger Lakes State Park, Stream Teams, pollutant allocations and best management practices. On September 6, 2003 TMDL Unit staff presented a program to a group of citizens living in rural Boone County in the Rocky Fork/Slack's Branch watershed to discuss the TMDL.

The Kelley Branch and Rocky Fork TMDL was placed on public notice from August 15, 2003 to September 14, 2003. Several comment letters were received, and the TMDL document was adjusted in response.

9.0 Administrative Record and Supporting Documentation:

An administrative record on the Kelley Branch/Rocky Fork TMDL has been assembled and is being kept on file with the Missouri Department of Natural Resources, including the following:

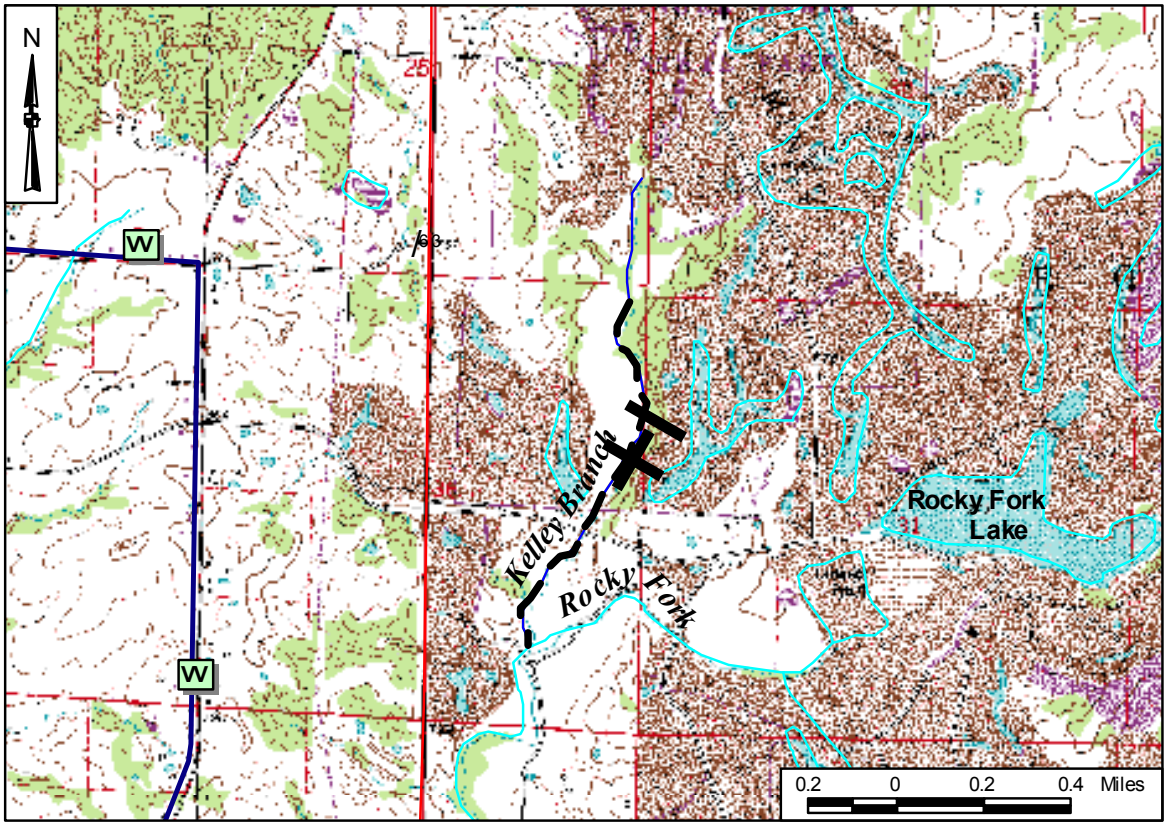
- Finger Lakes Abandoned Mine Land Closeout Report from Missouri DNR Land Reclamation.
- Finger Lakes State Park Natural Resource Management Plan.
- Memorandum from Randy Sarver, Environmental Services Program, Water Quality Monitoring Section on approaches to monitoring Kelley Branch/Rocky Fork for the TMDL.
- A series of e-mails regarding monitoring approaches for Kelley Branch/Rocky Fork from Ann Lavaty and Jack Generaux of the United State Environmental Protection Agency (USEPA), Randy Sarver, Environmental Services Program, Water Quality Monitoring Section, MDNR, Sharon Clifford and Gail Wilson, Planning Section, Water Pollution Control Program, MDNR.
- An e-mail from John Ford, Planning Section to Randy Sarver, Environmental Services Program, about the approach the monitoring section will take to gather data on the current state of Kelley Branch and Rocky Fork.
- An e-mail from Steve Fischer, Missouri Department of Conservation, describing the results of a fish study conducted on Kelley Branch, July 21, 2002.
- October 3, 2003 Missouri Department of Natural Resources, Planning Section inspection report.
- Rocky Fork/Finger Lakes Mining Area AMF/AML Workshop Field Site report from Missouri Department of Natural Resources, Land Reclamation Program, May 21, 2002.
- Kelley Branch and Rocky Fork TMDL Public Notice.
- Kelley Branch and Rocky Fork Information Sheet.
- Comment letters on the Kelley Branch and Rocky Fork TMDL and MDNR responses.

10.0 Appendices

- Appendix A -- Topographical maps of Kelley Branch and Rocky Fork showing impaired segments
- Appendix B -- Land use map
- Appendix C – Habitat Study
- Appendix D – Other reports

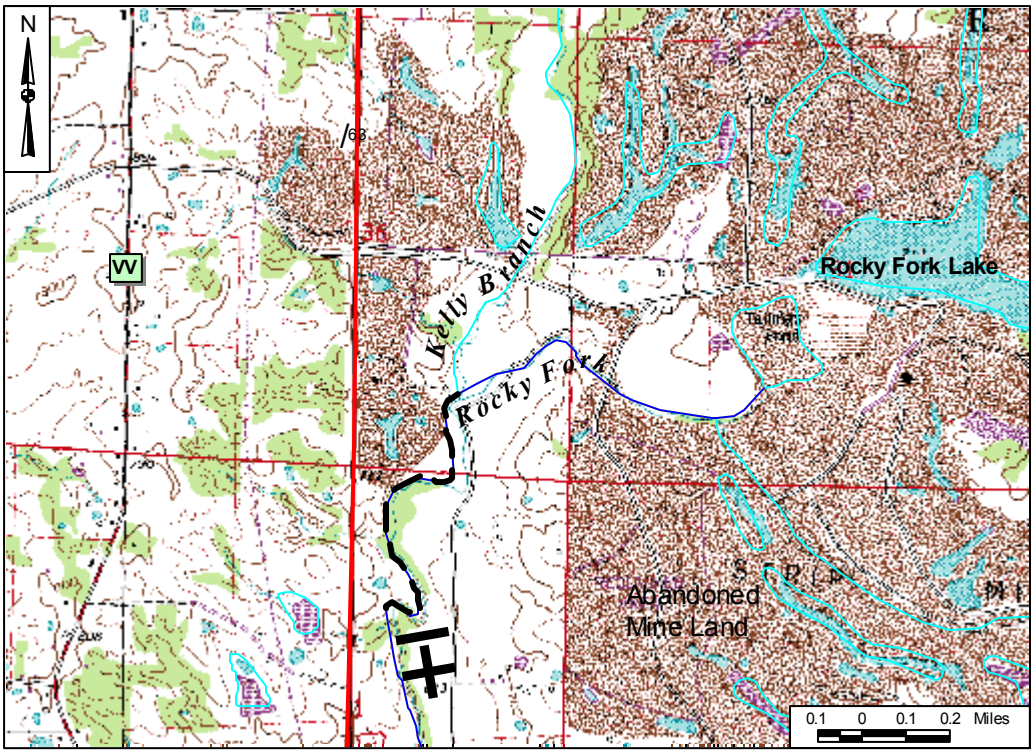
APPENDIX A
TOPOGRAPHICAL MAPS

Map of Impaired Portion of Kelley Branch



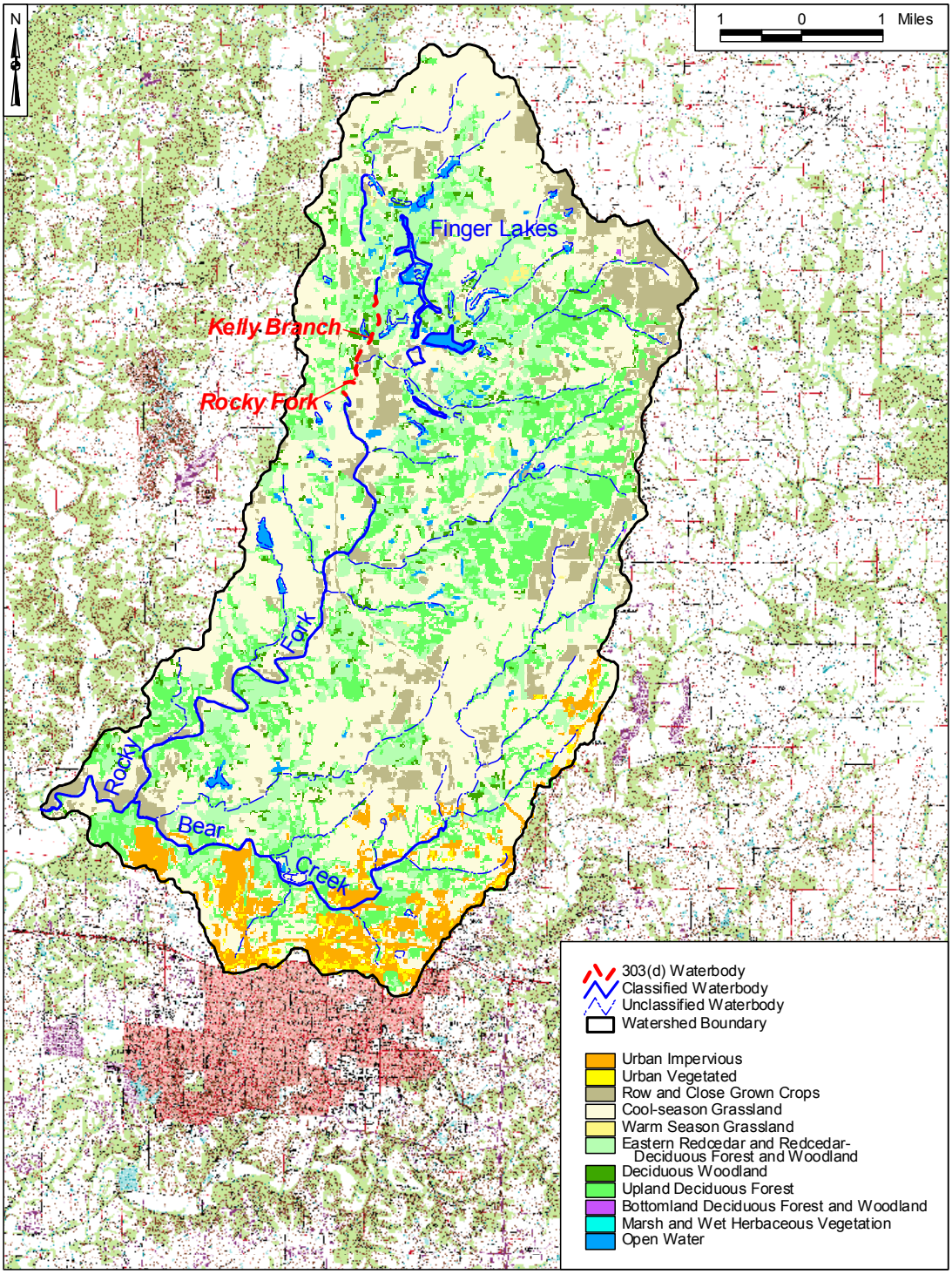
Impaired Segment → Direction of Flow

Map Showing Location of Impaired Portion of Rocky Fork



Impaired Segment → Direction of Flow

Appendix B
Kelley Branch and Rocky Fork Land Uses



Kelley Branch and Rocky Fork Land Uses	Acres
Urban Impervious	6537
Urban Vegetated	1139
Row and Close Grown Crops	12988
Cool-season Grassland	68120
Warm Season Grassland	324
Eastern Redcedar and Redcedar-Deciduous Forest/Woodland	24064
Deciduous Woodland	2709
Upland Deciduous Forest	23226
Bottomland Deciduous Forest and Woodland	24
Marsh and Wet Herbaceous Vegetation	7
Open Water	2375

Appendix C
Kelley Branch, Boone County Habitat Study

21 July 2000
Site begins 150 m upstream of main road into Finger Lakes State Park

WQ parameters: very little flow present, highly shaded site, water level low, evidence of ATV traffic throughout stream reach,

mean wetted width = 3.93 m
Temperature = 20.0C
Dissolved Oxygen = 7.0 ppm
pH = 7.6
Conductivity = 820
Discharge = 0.00014 m3/sec

Fish species list: very difficult for fish to move to this reach due to barrier produced by culverts @ bridge

Largemouth bass (all were young of year)
Orangethroat darter
Blackstripe topminnow
Bluegill
Creek Chub +++ most abundant species
Yellow bullhead
Common Shiner

Habitat: highly impacted by sedimentation resulting from ATV use through the stream and along the stream banks. Substrate = majority of the stream was highly embedded with sand/fine sediments (mean percent embeddedness from 50 transect measurements = 87.4%); some fine to course gravel present but very shallow water and highly embedded.

Fish Cover = virtually non-existent due to sedimentation in pools; limited woody debris.
Canopy = thick canopy
Riparian = ground cover = > 40% bare dirt
Thalweg depth = mean (100 measurements) = 14.9cm (5.9"); 91% of thalweg measurements had fine sediments present.

General comments:
Good canopy cover, but understory and ground cover are disturbed. Various ATV trails criss-cross and parallel stream. Much of the understory is disturbed from heavy ATV use. Stream has large amounts of sediment from ATV disturbances. Attempted to resample on 19 September 2000 but extremely low water prohibited sampling. Most pools were dry and ATV use within the stream was very heavy with new trails being worn at stream crossings. A very highly degraded site!

Steve Fischer
Fisheries Research Biologist
MO Dept of Conservation
1110 S College Ave

Columbia, MO 65201

Resource Assessment & Monitoring program Information

The Missouri Department of Conservation (MDC) is charged with managing Missouri's aquatic resources. Therefore, activities that affect aquatic resources such as gravel mining, sewage treatment, CAFOs, and poor land management practices are of major concern. Currently MDC is involved in a variety of activities to improve aquatic habitat and water quality. A statewide bioassessment program would establish a baseline of current conditions of Missouri's aquatic resources and allow us to determine the effectiveness of our management programs and seriousness of environmental threats.

Purpose

The purpose of this program is to assess the current status and to attempt to detect changes (trends) of various stream resource parameters (water quality, biology, physical habitat, etc.) across all of the state of Missouri. This will be done by using a random sampling design along with standardized sampling protocols (EPA R-EMAP protocols). Land use/land cover data layers and data from regional reference sites will also be employed. An evaluation or 'pilot study' was conducted during 2000-2001.

This program will provide an approach for the State to describe wadeable stream resources with known confidence at a statewide and ecological drainage unit (EDU) spatial and temporal scale. Missouri's Resource Assessment and Monitoring program (RAM), will operate on a 5 yr cycle – the first year is a statewide survey, while years 2 – 5 will focus on specific EDU's. Benefits of this program include: allow agencies to make better decisions because they could more easily share data and make comparisons within and between watersheds; expansion of existing water quality monitoring data that should lead to improved water quality management decisions at a local / watershed / statewide level; the ability to better identify, classify, inventory, and characterize aquatic habitats in Missouri; and establish a baseline for future aquatic resource trend analyses.

Program Objectives

1. Assess the status of various wadeable stream resource parameters (chemical, physical, and biological) on a statewide basis in Missouri.

2. Determine if changes (trends) in various wadeable stream resource parameters can be detected statewide by comparing data between years.

By meeting these project objectives the following assessment questions will be answered:

1. What are the status and changes regarding fish and benthic macroinvertebrate biological integrity in wadeable Missouri streams, and does this information indicate poor or good health?
2. What are the status and changes regarding selected contaminant concentrations in the water column, sediment, and fish tissue?
3. What are the status and changes regarding physical habitats in the wadeable streams of Missouri?

Population of Interest

The target population for this project will be all Missouri perennial warmwater wadeable streams. Since the primary focus of this study will be on determining biological integrity (health) of streams, it is

assumed that all or most perennial wadeable streams in Missouri have aquatic life populations.

Technical approach

The biotic health (integrity) of Missouri's wadeable streams will be assessed by measuring several biotic and abiotic factors. These include fish, benthic macroinvertebrates, water quality parameters, sediment, fish tissue samples, and habitat parameters. Habitat and landuse are key components that will be included to further assess the biotic integrity of Missouri streams.

Products

Aquatic Resources Status Report -- periodic reports to citizens, and in particular legislators, about the status, condition, and trends of Missouri's aquatic resources (biological, water quality, sediment, riparian corridor). A summary or results will also be posted on MDC's web site.

If you have any questions regarding this program, please do not hesitate to contact me!

Thanks!

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Appendix D
Other Reports

Summary of
THE ROCKY FORK/FINGER LAKES MINING AREA

BOONE COUNTY, MISSOURI
AFM/AML Workshop Field Site Report
May 21, 2002

The Finger Lakes/Rocky Fork area was strip-mined by the Peabody Coal Company from the late 1950s until 1972. Approximately 3500 acres of the Bevier coal seam were mined by a truck and shovel operation based around the tipple and shop site south of Rocky Fork Lake. Peabody called this the "Mark Twain" mine.

Approximately 5275 acres were strip-mined in Boone County by various mining companies from the late 1940s until 1972. Numerous small, underground mines worked the coal seams throughout the region from the 1870s until the 1930s for local use. The Rocky Fork area has a 3-to-4-foot-thick, acid-forming black shale above the Bevier coal seam that limits plant growth. A 5- to 10-foot thick shale of the Lagonda formation also is acid forming. Therefore, portions of the Rocky Fork area have limited plant establishment and soil development. As a result, erosion and deposition of acidic mine spoils degraded Rocky Fork and associated tributaries. Deep glacial till deposits up to 25-30 feet deep are found on broad ridges, foot slopes and ancient terraces. Often this till was spoiled by Peabody in the mining process, mixing and diluting the effects of the acid-forming overburden by sheer volume and the calcareous nature of the deepest layers of the till. Apparently very little glacial till, or "good" overburden, was present to mix with the bad minespoil to help with revegetation.

Acid-forming coal waste is scattered throughout the "big lake area." Two coal slurry ponds and a coal waste pile were located south of the conservation area lake. The main slurry dam breached on several occasions during the mining operation, causing particularly large fish kills in 1970 and 1972. The coal company dumped gob into the breach from the pile near the tipple since it was closest and the most easily obtainable fill. Most of the haul roads and railroad sidings were constructed with gob because it compacts well and dries like concrete. Some of the gob and slurry is now uncovered and is once again eroding through a new breach in the dam. Coal slurry was pumped into the bottoms of nearby strip pits when the slurry pond became filled. Much of this slurry remains on the strip pit floors but is now flooded. Near surface groundwater quality is very poor and mineralized. Occasionally, acid mine drainage seeps downslope from these pits, killing vegetation and degrading surface waters. Acidic seeps and acidified pits are often the legacies of spreading coal slurry throughout the area.

The coal mining ceased at Mark Twain Mine in 1972. In 1971, the Missouri General Assembly passed its first state reclamation law for coal mining. Peabody management decided to close the Mark Twain Mine rather than continue mining so close to Columbia.

Several fish kills occurred in the Rocky Fork watershed in the 1960s as a result of coal mining, with 1970 and 1972 as notoriously bad years. The 1970 and 1972 fish kills affected 5 and 3

miles of Rocky Fork Creek respectively. Throughout the period, Peabody planted trees and shrubs to stabilize the areas, however, these plantings account for the large number of introduced tree and shrub species found on both Finger Lakes and Rocky Fork.

The Missouri Old Law required Peabody to reclaim the slurry ponds and coal waste pile by placing at least two feet of cover and establishing "permanent vegetation." Mine spoil was taken from the east, and glacial till and alluvium from unmined areas to the west to provide the cover material. In the mid-1980s, the slurry pond once again breached, resulting in erosion of coal waste from the pond and deposition of acidic sediments in the Rocky Fork flood plain. The long-term success of the reclamation is questionable. Much of this work south of Rocky Fork Lake is being "burned out" by acid-forming materials 25 years afterward.

In 1973, Peabody donated 1,100 acres to Missouri State Parks (a division of the Department of Natural Resources), which was named Finger Lakes State Park. It was converted into an off-the-road vehicle facility with 70 miles of "groomed" trails and raceways. The extensive and largely uncounted trails through the mine spoils are easily eroded, causing a huge discharge of sediments into an unnamed tributary of Rocky Fork Creek. Several strip pits have been improved for public use by building new dams, disabled fishing access, boat ramps and swimming beaches.

In 1981, Peabody sold 2,024 acres to the Missouri Department of Conservation to create the Rocky Fork Conservation Area. There are 25 large strip pits and lakes totaling more than 200 surface acres of water, with the "Big Lake" being the largest at 50 acres. Fishing, hunting, hiking and target shooting are the main activities, with no vehicles allowed off the public roads. Public use of both Rocky Fork and Finger Lakes is very high due to their proximity to Columbia, the large numbers of strip pits in which to fish, and to the regional motorcycle races held at Finger Lakes.

Inspection of Rocky Fork, Boone County

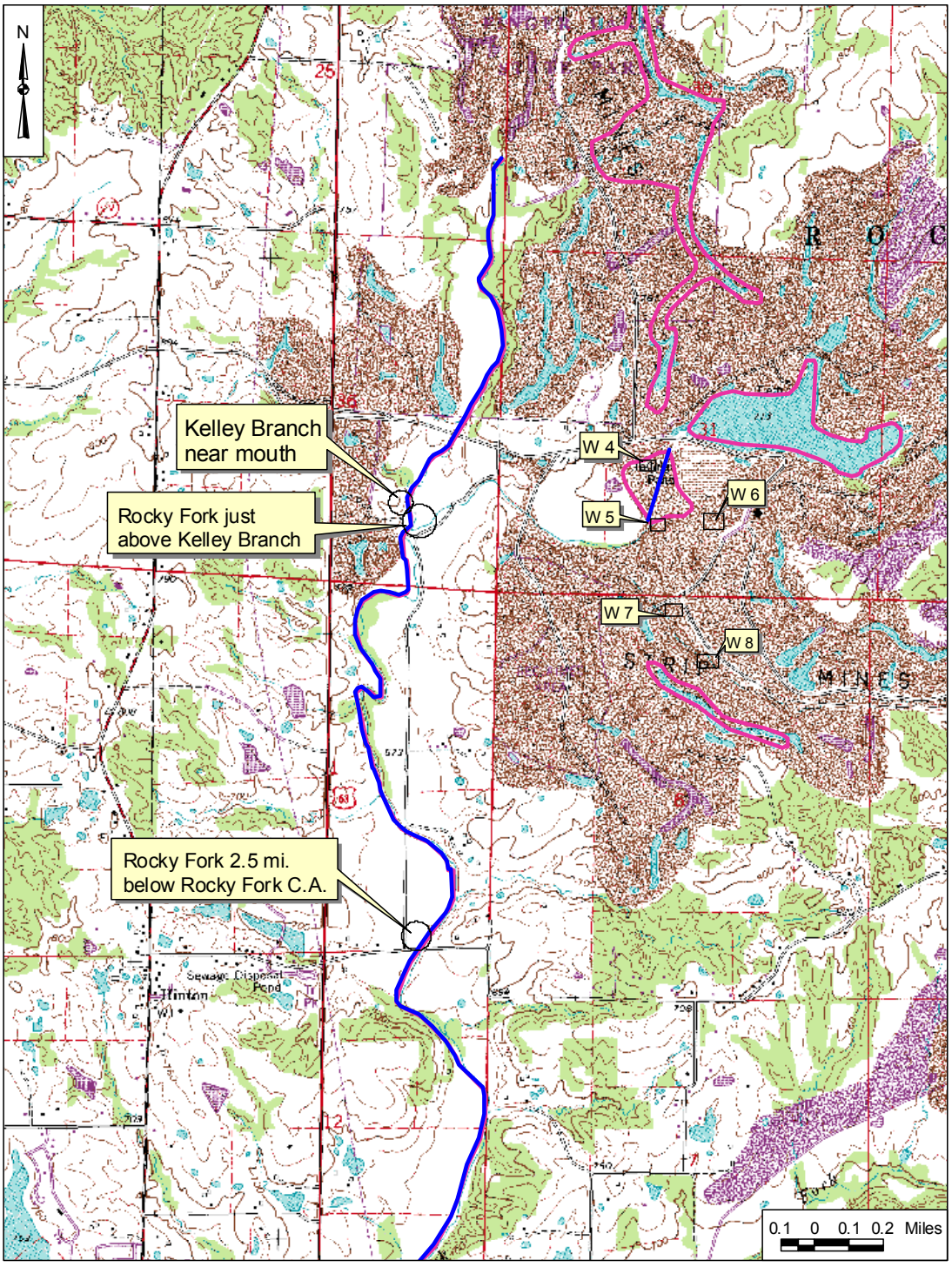
On October 3, 2003 staff of the Department of Natural Resources, Water Pollution Control Program inspected Rocky Fork and Coal mine waste areas within the Rocky Fork Conservation Area.

Location	Flow	SC umhos	pH	Comments
Rocky Fk. 2.5 miles below Rocky Fork CA (SESE 1)	0.7 cfs	883	7.4	Water clear, substrate was gravel and cobble with moderate amounts of sand
Rocky Fk. 0.7 mi. below RFCA, and just upstream of Kelley Branch	0.4 cfs	880	7.6	Water clear, substrate was gravel and cobble
Kelley Branch just upstream of confluence with Rocky Fk.	0.3 cfs	828	7.7	Water moderately turbid, substrate was gravel and large amounts of sand
W-4. Seep from slurry pond to main drainage along north side of slurry pond	None	2120	6.7	This northern area of the slurry pond was well vegetated. This small gully was the only one we found in this area
W-5. Erosion gullies along western face of slurry pond dam	<.001	3560	6.1	These areas are depositing spoil just below dam on flat ground. The entire area down-stream of the slurry pond dam drains to a large, low marshy area with some standing water
W-6. Ditch draining pond near gob pile	<.001	2190	6.8	Headcutting ditch is within 5 feet of breaching dam of this pond. Pond receives drainage from eastern end of gob area
W-7. Ditch draining gob and spoil area	0.02	4060	2.7	Drainage goes to same low area as the slurry pond drainage
W-8. Ditch draining spoil area	<.001	4280	2.9	Drainage goes to same low area as the slurry pond drainage

SC = Specific conductance

This area had received about 8 inches of rainfall in the last month but less than one inch in the preceding week. Despite the presence of small discharges of acid water from the spoil and gob area immediately south of the slurry pond, there was no evidence of acidity in Rocky Fork itself. There is a large wetland (60-70 acres) to the west that receives the drainage from about 98% of the slurry pond and the gob and spoil areas immediately south of the slurry pond. This wetland prevents loss of settleable and most suspended solids to Rocky Fork and provides buffering for acid drainage. At the current time, Rocky Fork does not appear to be affected by drainage from this site, but erosion gullies on the face of the slurry pond dam and the headcutting near the gob pile should be addressed to prevent the exposure of more acid forming materials.

The following map shows sampling locations. W-4 through W-8 refer to locations in the chart above.


N
Kelley Branch near mouth
Rocky Fork just above Kelley Branch
Rocky Fork 2.5 mi. below Rocky Fork C.A.
W 4
W 5
W 6
W 7
W 8
R O C
S T R I P
M I N E S
Hinton
Sewage Disposal Pond
0.1 0 0.1 0.2 Miles